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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/536,993	05/31/2005	Toshitsugu Sakamoto	8017-1169	9950
<small>465</small> YOUNG & THOMPSON 209 Madison Street Suite 500 ALEXANDRIA, VA 22314			<small>7590</small> EXAMINER CRUZ, LESLIE PILAR	
			ART UNIT 2826	PAPER NUMBER
			MAIL DATE 06/27/2008	DELIVERY MODE PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

### Office Action Summary

**Application No.**

10/536,993

**Applicant(s)**

SAKAMOTO ET AL.

**Examiner**

Leslie P. Cruz

**Art Unit**

2826

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 06 May 2008.  
2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.  
3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-8, 20, 21, 27 and 29 is/are pending in the application.  
4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.  
5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.  
6) ☒ Claim(s) 1-8, 20, 21, 27 and 29 is/are rejected.  
7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.  
8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.  
10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).  
11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☒ All b) ☐ Some \* c) ☐ None of:  
1. ☒ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)  
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)  
3) ☐ Information Disclosure Statement(s) (PTO/S508)  
Paper No(s)/Mail Date \_\_\_\_\_  
4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_\_  
5) ☐ Notice of Informal Patent Application  
6) ☐ Other: \_\_\_\_\_

## **DETAILED ACTION**

### ***Continued Examination Under 37 CFR 1.114***

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 06 May 2008 has been entered.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 1-8, 20 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Haase (US 2003/0211724 A1) in view of Choi (US 2002/0197752 A1).

With respect to claim 1, Haase (Figs. 1 & 2) discloses a semiconductor device comprising a connection plug [40] defined by a via hole filled with a nanomaterial [32, 48], wherein the nanomaterial is substantially uniformly disposed in a section of the via hole. Haase does not specify the via hole is filled with a metal, the nanomaterial surrounded by the metal, wherein the metal both surrounds the nanomaterial and fills the via hole from a bottommost surface of the via hole to a topmost height of the via

hole. However, Choi (Fig. 3A-4C) discloses it is well known in the art for a via hole [112c] to be filled with a metal [112b], comprising a nanomaterial [112a] surrounded by the metal, wherein the metal both surrounds the nanomaterial and fills the via hole from a bottommost surface of the via hole to a topmost height of the via hole. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made for the via hole of Haase to be filled with a metal, the nanomaterial surrounded by the metal, wherein the metal both surrounds the nanomaterial and fills the via hole from a bottommost surface of the via hole to a topmost height of the via hole, such as taught by Choi, in order to improve the integrity of the connection plug [Choi, paragraph 0012].

With respect to claim 3, Haase in view of Choi discloses the semiconductor according to claim 1. Haase further discloses the nanomaterial is a fibrous carbon nanomaterial or a particle-like carbon nanomaterial [paragraph 0015].

With respect to claim 5, Haase in view of Choi discloses the semiconductor according to claim 1. Haase (Figs. 1 & 2) further discloses the nanomaterial is oriented substantially perpendicularly to a substrate [16, paragraph 0020].

With respect to claim 7, Haase in view of Choi discloses the semiconductor according to claim 1. Haase (Fig. 1) further discloses the nanomaterial is provided in the whole connection plug.

With respect to claim 20, Haase in view of Choi discloses the semiconductor according to claim 1. The limitation "metal layer is formed by a plating liquid comprising the nanomaterial" is a product by process limitation and is not given patentable weight.

Therefore, claim 20 is not patentable distinguishable over the Haase in view of Choi reference. See note below.

With respect to claim 2, Haase (Figs. 1 & 2) discloses a semiconductor device comprising: an insulating film [16]; an interlayer dielectric film [26] on the insulating film; a trench [24] within the dielectric film; an interconnection [40] comprising nanotubes [32, 48], wherein the nanotubes are of a nanomaterial substantially uniformly formed on a bottom surface of the interconnection [paragraph 0015, 0021]. Haase does not specify that a metal fills the trench from a bottommost surface of the trench to a topmost height of the trench and the nanotubes are mixed in the metal. However, Choi (Fig. 3A-4C) discloses it is well known in the art for a metal [112b] to fill the trench from a bottommost surface of the trench to a topmost height of the trench and the nanotubes [112a] are mixed in the metal. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made for a metal to fill the trench of Haase from a bottommost surface of the trench to a topmost height of the trench and the nanotubes are mixed in the metal, such as taught by Choi, in order to improve the integrity of the connection plug [Choi, paragraph 0012].

With respect to claim 4, Haase in view of Choi discloses the semiconductor device according to claim 2. Haase further discloses the nanomaterial is a fibrous carbon nanomaterial or a particle-like carbon nanomaterial [paragraph 0015].

With respect to claim 6, Haase in view of Choi discloses the semiconductor device according to claim 2. Haase (Figs. 1 & 2) further discloses the nanomaterial is oriented substantially perpendicular to a substrate [16, paragraph 0020].

With respect to claim 8, Haase in view of Choi discloses the semiconductor device according to claim 2. Haase (Figs. 1 & 2) further discloses the nanomaterial is provided up to the vicinity of a top surface of the interconnection.

With respect to claim 21, Haase in view of Choi discloses the semiconductor according to claim 2. Haase (Figs. 1 & 2) further discloses the conductive barrier material comprises the nanomaterial. The limitation "metal layer is formed by a plating method a plating liquid comprising the nanomaterial" is a product by process limitation and is not given patentable weight. Therefore, claim 20 is not patentable distinguishable over the Haase in view of Choi reference. See note below.

### ***Product by Process***

Note that a "product by process" claim is directed to the product per se, no matter how actually made, *In re Hiraio*, 190 USPQ 15 at 17 (footnote 3). See also *In re Brown*, 173 USPQ 685; *In re Luck*, 177 USPQ 523; *In re Fessmann*, 180 USPQ 324; *In re Avery*, 186 USPQ 161; *In re Wertheim*, 191 USPQ 90 (209 USPQ 554 does not deal with this issue); and *In re Marosi et al.*, 218 USPQ 289, all of which make it clear that it is the patentability of the final product per se which must be determined in a "product by process" claim, and not the patentability of the process, and that an old or obvious product produced by a new method is not patentable as a product, whether claimed in "product by process" claims or not. Note that applicant has the burden of proof in such cases, as the above case law makes clear. See also MPEP § 706.03(e).

***Response to Arguments***

Applicant's arguments with respect to claims 1 and 2 have been considered but are moot in view of the new ground(s) of rejection.

***Allowable Subject Matter***

Claims 27 and 29 are allowable over the prior art of record.

The following is a statement of reasons for the indication of allowable subject matter:

The prior art of record taken either singly or in combination fails to anticipate or fairly suggest the limitations which the Applicant claims in claim 27 in a manner which would warrant a rejection under 35 U.S.C. § 102 or 35 U.S.C. § 103.

There was no prior art found by the examiner that suggested modification or combination with the cited prior art so as to satisfy the combination of the present independent claim 27; especially, the prior art does not provide that each of i) the trench, ii) the interconnection, iii) the metal layer, iv) the barrier metal layer, and the carbon nanotubes extend through the first etching stopper layer as recited in claim 27.

***Telephone/Fax Information***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Leslie P. Cruz whose telephone number is 571-272-8599. The examiner can normally be reached on Monday-Friday 9:00-5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisors, Sue A. Purvis can be reached on 571-272-1236. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Minh-Loan T. Tran/  
Primary Examiner  
Art Unit 2826

Leslie Pilar Cruz  
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